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Perceived neighborhood safety and sleep quality: a global analysis of six countries

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ABSTRACT

Objective: Building on previous North American and European studies of neighborhood context and sleep quality, we tested whether several self-reported sleep outcomes (sleep duration, insomnia symptoms, sleepiness, lethargy, and overall sleep quality) vary according to the level of perceived neighborhood safety in six countries: Mexico, Ghana, South Africa, India, China, and Russia.
Methods: Using data (n = 39,590) from Wave I of the World Health Organization's Longitudinal Study on Global Ageing and Adult Health (2007–2010), we estimated a series of multinomial and binary logistic regression equations to model each sleep outcome within each country.
Results: Taken together, our results show that respondents who feel safe from crime and violence in their neighborhoods tend to exhibit more favorable sleep outcomes than respondents who feel less safe. This general pattern is especially pronounced in China and Russia, moderately evident in Mexico, Ghana, and South Africa, and sporadic in India. Perceptions of neighborhood safety are strongly associated with insomnia symptoms and poor sleep quality (past 30 days), moderately associated with sleepiness, lethargy, and poor sleep quality (past 2 days), and inconsistently associated with sleep duration (past two days).
Conclusions: We show that perceived neighborhood safety is associated with more favorable self-reported sleep outcomes in six understudied countries. Additional research is needed to replicate our findings using longitudinal data, more reliable neighborhood measures, and more direct measures of sleep quality in these and other regions of the world.

1. Introduction

Studies consistently show that living in a disadvantaged neighborhood that is characterized by poverty, social disorganization, and disorder is associated with a range of adverse sleep outcomes [1–13]. This growing body of work is impressive because it is remarkably stable across studies of younger and older populations, objective (census indicators of neighborhood socioeconomic disadvantage) and perceived (fear of crime in the neighborhood) neighborhood characteristics, and clinical (obstructive sleep apnea) and self-reported (sleep duration and sleep problems) sleep outcomes. Although previous research has made significant contributions to our understanding of neighborhood contextual variations in sleep outcomes, it is unclear whether these general patterns extend beyond the United States. Some studies in Canada [2,3], England [13], and Germany [11] have been conducted, but regions of the world beyond North America and Europe remain largely unexamined.

In this paper, we build on previous research by testing whether several self-reported sleep outcomes (sleep duration, insomnia symptoms, sleepiness, lethargy, and overall sleep quality) vary according to the level of perceived neighborhood safety (PNS) in six countries: Mexico, Ghana, South Africa, India, China, and Russia. PNS refers to the subjective experience of security and vulnerability to crime and violence in the neighborhood environment. Researchers speculate that, because sleep is an adaptive behavior, neighborhoods that are characterized by noise (from neighbors, busy streets, and crowding), dilapidation (substandard housing), and crime (fear of victimization) may directly undermine the ability of residents to initiate and/or maintain sleep [4–6,12]. Studies also suggest that stressful neighborhood conditions could contribute to poor sleep quality through various psychological and physiological pathways. For example, perceptions of noise and crime could elicit short-term feelings of annoyance, fear, and hopelessness [5,6,12]. These feelings could effectively activate the stress response and trigger the release of stress hormones (epinephrine and cortisol) that promote

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mental and physiological arousal [14–16]. In accordance with previous empirical work and these theoretical perspectives, we expect that respondents who feel safe from crime and violence in their neighborhoods will tend to exhibit more favorable sleep outcomes than respondents who feel less safe in their neighborhoods.

2. Material and methods

2.1. Data

The data for this investigation come from Wave I of the World Health Organization's (WHO) longitudinal Study on Global Ageing and Adult Health (SAGE). The primary purpose of the SAGE is to examine the health and well-being of adult populations and the aging process around the world (http://www.who.int/healthinfo/sage/en/). The SAGE is based on a multistage cluster sample of adults aged 50 years and older and a smaller comparison sample of adults aged 18–49 years. The SAGE includes nationally representative samples from six countries: Mexico ($n = 2756$), Ghana ($n = 5110$), South Africa ($n = 4223$), India ($n = 11{,}230$), China ($n = 14{,}813$), and the Russian Federation ($n = 4355$). The data were collected between 2007 and 2010. Overall, response rates ranged from 51% (Mexico) to 90% (China). For most countries, response rates ranged from 70% (India) to 80% (Ghana, South Africa, and Russia). Due to missing information on our focal variables, our final analytic samples were reduced as follows: Mexico ($n = 2625$), Ghana ($n = 4370$), South Africa ($n = 3854$), India ($n = 11{,}077$), China ($n = 14{,}046$), and Russia ($n = 3618$).

2.2. Measures

PNS, our focal predictor variable, is measured as the mean response to two items: "How safe do you feel when walking down your street alone after dark?" and "In general, how safe from crime and violence do you feel when you are alone at home?" Responses for both items range from (1) not safe at all to (5) completely safe, so that higher values on the index indicate higher levels of PNS. Reliability and correlation estimates for these two items are as follows: Mexico ($\alpha = 0.68$, $r = 0.52$), Ghana ($\alpha = 0.79$, $r = 0.66$), South Africa ($\alpha = 0.75$, $r = 0.61$), India ($\alpha = 0.84$, $r = 0.73$), China ($\alpha = 0.68$, $r = 0.54$), and Russia ($\alpha = 0.60$, $r = 0.43$).

Our focal dependent variables include seven common indicators of sleep quality, including short sleep duration (past two days), long sleep duration (past two days), insomnia symptoms (past 12 months), sleepiness (past 24 hours), lethargy (past 30 days), overall sleep quality (past two days), and overall sleep quality (past 30 days).

Sleep duration (past two days) is measured as the mean response to two items: hours of sleep last night and the night before. Depending on the day of the interview, both of these items could refer to weekdays or weekends. The continuous distribution of sleep hours was divided into three categories to indicate short sleep (<7 h), long sleep (>8 h), and normal sleep (7–8 h). Reliability and correlation estimates for these two items are as follows: Mexico (data not available), Ghana ($\alpha = 0.62$, $r = 0.46$), South Africa ($\alpha = 0.69$, $r = 0.53$), India ($\alpha = 0.81$, $r = 0.68$), China ($\alpha = 0.85$, $r = 0.74$), and Russia ($\alpha = 0.12$, $r = 0.08$).

Insomnia symptoms (past 12 months) are measured with a single item: "[During the last 12 months] did you notice any problems falling asleep?" Responses to this item are dummy-coded (1) yes and (0) no.

Sleepiness (past 24 hours) is measured with a single item: "Looking at the whole day (morning, afternoon, AND evening), did you feel sleepiness?" Responses to this item are dummy-coded (1) yes and (0) no.

Lethargy (past 30 days) is measured with a single item: "Overall in the last 30 days, how much of a problem did you have due to not feeling rested and refreshed during the day (for example, feeling tired, not having energy)?" Original response categories included (1) none, (2) mild, (3) moderate, (4) severe, and (5) extreme/cannot do. We dummy-coded these responses as (1) severe or extreme/cannot do and (0) none, mild, or moderate.

Overall sleep quality (past 2 days) is measured as the mean response to two items: "Please rate the quality of your sleep last night" and "Please rate the quality of your sleep the night before last." The original responses for these items included (1) very good, (2) good, (3) moderate, (4) poor, and (5) very poor. We dummy-coded these responses as (1) poor or very poor and (0) very good, good, or moderate. Reliability and correlation estimates for these two items are as follows: Mexico (data not available), Ghana ($\alpha = 0.80$, $r = 0.67$), South Africa ($\alpha = 0.79$, $r = 0.66$), India ($\alpha = 0.78$, $r = 0.64$), China ($\alpha = 0.90$, $r = 0.81$), and Russia ($\alpha = 0.74$, $r = 0.59$).

Overall sleep quality (past 30 days) is measured with a single item: "Overall in the last 30 days, how much of a problem did you have with sleeping, such as falling asleep, waking up frequently during the night or waking up too early in the morning?" Original response categories included (1) none, (2) mild, (3) moderate, (4) severe, and (5) extreme/cannot do. Consistent with previous work [17], we dummy-coded these responses as (1) severe or extreme/cannot do and (0) none, mild, or moderate. This item is similar to question 6 of the Pittsburgh Sleep Quality Index, and is often used to measure sleep quality [18].

Following previous research [4–6,17,19], subsequent multivariate analyses control for age (continuous years), gender (1 = female; 0 = male), education (1 = ≥ high school; 0 = < high school), employment status (1 = employed; 0 = unemployed), and household income (within-country quartiles). Because ambient threats to security in the neighborhood environment are often correlated with realized threats [20], we also adjust for the potential confounding influence of personal victimization (1 = victim of a violence crime; 0 = no victimization).

2.3. Statistical procedures

Our analyses begin with the presentation of descriptive statistics for all study variables, including variable ranges (minimum and maximum values across countries), means, and standard deviations (Table 1). We use multinomial logistic regression to model sleep duration (Table 2). In these analyses, midrange or normal sleep is the reference category against which short and long sleep are compared. We also use binary logistic regression to model insomnia symptoms, sleepiness, lethargy, and both sleep quality measures (Table 2). In both sets of analyses, we present odds ratios and 95% confidence intervals for corresponding independent variables. The odds ratios are interpreted as the estimated difference in the odds of being classified in the category of interest for those who are one unit apart on a given predictor variable, controlling for all other predictors in the model. All analyses were performed using Stata 12.

3. Results

3.1. Descriptive analyses

According to Table 1, the mean levels of PNS vary across countries. The average respondent in Ghana, India, and China reports feeling "very safe" from crime and violence and when walking down their street alone after dark. Respondents in Mexico and Russia report feeling "moderately safe." Respondents in South Africa report feeling only "slightly safe." In Ghana, India, China, and Russia, respondents report sleeping just over 7 h per night (averaged over the past two nights). South African respondents report sleeping over 8 h. Consistent with these patterns, nearly half of the respondents in Ghana, India, China, and Russia were classified as normal sleepers (7–8 h per night), while only one third of South African respondents were classified in this way. In fact, over half

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Table 1
Descriptive statistics (World Health Organization Study on Global Aging and Adult Health, 2007–2010).[a]

	Range[b]	Mexico	Ghana	South Africa	India	China	Russia
Perceived Neighborhood Safety	1–5	3.08 (1.04)	4.04 (0.86)	2.28 (1.08)	3.70 (1.05)	3.80 (0.71)	2.80 (0.97)
Sleep Duration (2 days)	0–24	NA	7.53 (1.93)	8.49 (2.24)	7.15 (1.51)	7.57 (1.74)	7.07 (2.20)
Short Sleep (2 days)	0–1	NA	0.25	0.13	0.33	0.24	0.31
Normal Sleep (2 days)	0–1	NA	0.45	0.34	0.51	0.51	0.46
Long Sleep (2 days)	0–1	NA	0.30	0.52	0.15	0.25	0.23
Sleepiness (24 hours)	0–1	0.19	0.17	0.09	0.28	0.06	0.27
Insomnia (12 months)	0–1	0.03	0.08	0.04	0.10	0.01	0.06
Lethargy (30 days)	0–1	0.05	0.06	0.07	0.11	0.02	0.10
Poor Sleep Quality (2 days)	0–1	NA	0.07	0.07	0.07	0.12	0.15
Poor Sleep Quality (30 days)	0–1	0.06	0.06	0.08	0.10	0.02	0.12
Age	18–116	63.67 (14.30)	59.64 (14.12)	60.28 (12.31)	49.99 (16.59)	60.32 (11.80)	61.92 (12.99)
Female	0–1	0.62	0.53	0.57	0.61	0.53	0.64
≥ High School	0–1	0.06	0.23	0.12	0.17	0.20	0.73
Employed	0–1	0.15	0.72	0.27	0.42	0.43	0.39
Income (Q1)	0–1	0.40	0.35	0.38	0.37	0.39	0.36
Income (Q2)	0–1	0.20	0.20	0.19	0.19	0.20	0.20
Income (Q3)	0–1	0.20	0.22	0.21	0.21	0.21	0.20
Income (Q4)	0–1	0.20	0.22	0.21	0.23	0.21	0.23
Victimization	0–1	0.09	0.04	0.10	0.03	0.02	0.02
Sample Size		2625	4370	3854	11,077	14,046	3618

[a] Shown are means with standard deviations in parentheses.
[b] Ranges represent minimum and maximum values across countries.

of the South African respondents were classified as long sleepers (over 8 h per night). We observed low rates of insomnia symptoms and lethargy across countries. Respondents from India reported the highest rates of insomnia symptoms (10%) and lethargy (11%). Sleepiness was more prevalent. Nearly 30% of respondents from India and Russia reported sleepiness during the day. Approximately 20% of respondents from Mexico and Ghana reported the same issue. Finally, respondents reported low rates of poor sleep quality across countries. Russian respondents reported the highest rates: 15% in the past two days, and 12% in the past 30 days.

3.2. Multivariate analyses

In Table 2, we observe several statistically significant associations with short sleep duration in the past 2 days. PNS is associated with a *reduction* in the odds of short sleep (as compared with midrange or normal sleep) in Ghana and China. In other words, respondents in these countries who feel safe from crime and violence and when walking down the street alone after dark tend to experience fewer episodes of short sleep than respondents who feel less safe in their neighborhoods. The odds ratios suggest that each unit increase in PNS is associated with a 56% reduction in the odds of short sleep duration in Ghana and a 28% reduction in China. Interestingly, PNS is associated with an *increase* in the odds of short sleep duration in India. The odds ratio for India indicates that each unit increase in PNS is associated with a 25% increase in the odds of short sleep duration. Among respondents from India, episodes of short sleep are more common when levels of PNS are higher. In South Africa and Russia, we find that the odds of short sleep do not vary according to the level of PNS. In supplemental analyses (not shown), we coded short sleep duration as less than 6 hours. The results are substantively identical to those shown in Table 2.

For the most part, PNS is unrelated to the odds of long sleep duration. There is one exception to this general pattern. In South Africa, PNS is associated with a *reduction* in the odds of long sleep duration (as compared with midrange or normal sleep duration). The odds ratio for this country suggests that each unit increase in PNS is associated with a 39% reduction in the odds of long sleep duration. Additional supplemental analyses (not shown) coded long sleep as >10 h. The results are substantively identical to those shown in

Table 2
Regression of sleep outcomes on neighborhood safety and control variables (World Health Organization Study on Global Aging and Adult Health, 2007–2010).[a,b]

	Mexico	Ghana	South Africa	India	China	Russia
Neighborhood Safety → Short Sleep (2 days)[c]	NA	0.44 (0.33, 0.58)***	1.04 (0.87, 1.28)	1.25 (1.11, 1.41)***	0.72 (0.60, 0.87)**	1.05 (0.87, 1.29)
Neighborhood Safety → Long Sleep (2 days)[c]	NA	0.95 (0.69, 1.30)	0.61 (0.52, 0.71)***	1.03 (0.88, 1.20)	0.83 (0.66, 1.05)	1.13 (0.89, 1.42)
Neighborhood Safety → Insomnia (12 months)	0.49 (0.36, 0.69)***	0.52 (0.37, 0.71)***	0.96 (0.67, 1.38)	0.73 (0.62, 0.87)***	0.22 (0.13, 0.37)***	0.59 (0.43, 0.81)**
Neighborhood Safety → Sleepiness (24 hours)	0.76 (0.60, 0.96)*	0.76 (0.58, 0.99)*	0.94 (0.75, 1.17)	0.96 (0.85, 1.08)	0.39 (0.28, 0.53)***	0.66 (0.55, 0.79)***
Neighborhood Safety → Lethargy (30 days)	0.74 (0.47, 1.15)	1.44 (0.77, 2.71)	0.75 (0.58, 0.97)*	0.76 (0.64, 0.91)**	0.39 (0.22, 0.68)**	0.51 (0.38, 0.67)***
Neighborhood Safety → Poor Sleep (2 days)	NA	0.67 (0.45, 0.98)*	0.72 (0.55, 0.94)*	1.00 (0.80, 1.26)	0.46 (0.37, 0.58)***	0.58 (0.47, 0.72)***
Neighborhood Safety → Poor Sleep (30 days)	0.59 (0.40, 0.87)*	1.47 (0.75, 2.89)	0.76 (0.60, 0.98)*	0.79 (0.65, 0.95)**	0.49 (0.30, 0.80)**	0.54 (0.42, 0.70)***
Sample Size	2625	4370	3854	11,077	14,046	3618

[a] Shown are odds ratios with 95% confidence intervals (in parentheses) and two-tailed significance tests (* $p < 0.05$; ** $p < 0.01$;*** $p < 0.001$).
[b] All models control for age, gender, education, employment, income, and victimization.
[c] Reference is normal sleep.

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Table 2, with one exception. In India, PNS is unrelated to long sleep when the cutoff is >8 h. When the cutoff is >10 h, PNS is associated with a *reduction* in the odds of long sleep duration (OR = 0.68, 95% C.I. = 0.51, 0.91, $p = 0.009$).

PNS is most consistently related to insomnia symptoms in the past 12 months. Specifically, PNS is associated with *reduction* in the odds of insomnia symptoms in Mexico, Ghana, India, China, and Russia. These results suggest that respondents in these countries who report higher levels of PNS tend to experience problems with falling asleep less frequently than respondents who report lower levels of PNS. Statistically significant odds ratios range from 0.73 (India) to 0.22 (China). These estimates indicate that each unit increase in PNS is associated with a 27% reduction in the odds of insomnia symptoms in India and a 78% reduction in China. PNS is unrelated to the odds of insomnia in South Africa.

PNS is associated with a reduction in the odds of sleepiness in the past 24 h in Mexico, Ghana, China, and Russia. In other words, respondents in these countries who report higher levels of PNS experience sleepiness during the day less often than respondents who report lower levels of PNS. Statistically significant odds ratios range from 0.76 (Mexico and Ghana) to 0.39 (China). These estimates indicate that each unit increase in PNS is associated with a 24% reduction in the odds of sleepiness in Mexico and Ghana and a 61% reduction in China. PNS is unrelated to the odds of sleepiness in South Africa and India.

PNS is also associated with a *reduction* in the odds of lethargy in the past 30 days in South Africa, India, China, and Russia. These results indicate that respondents in these countries who report higher levels of PNS are less likely to experience "severe" or "extreme" problems with not feeling rested and refreshed during the day, feeling tired, or not having energy in the past 30 days. Statistically significant odds ratios range from 0.76 (India) to 0.39 (China). These estimates suggest that each unit increase in PNS is associated with a 24% reduction in the odds of severe or extreme lethargy in the past 30 days in India and a 61% reduction in China. PNS is unrelated to lethargy in Mexico and Ghana.

PNS is associated with a *reduction* in the odds of poor overall sleep quality in the past 2 days in Ghana, South Africa, China, and Russia. This means that respondents in these countries are less likely to rate the quality of their sleep as "poor" or "very poor" when they perceive higher levels of neighborhood safety. Statistically significant odds ratios range from 0.72 (South Africa) to 0.46 (China). These estimates suggest that each unit increase in PNS is associated with a 28% reduction in the odds of poor overall sleep quality in the past 2 days in South Africa and a 54% reduction in China. PNS is unrelated to the odds of poor overall sleep quality in the past 2 days in India.

Along with insomnia symptoms, PNS is most consistently related to poor overall sleep quality in the past 30 days. In fact, PNS is associated with a reduction in the odds of poor overall sleep quality in the past 30 days in Mexico, South Africa, India, China, and Russia. These results indicate that respondents in these countries who report higher levels of PNS are less likely to report "severe" or "extreme" problems with sleeping, such as falling asleep, waking up frequently during the night, or waking up too early in the morning. Statistically significant odds ratios range from 0.79 (India) to 0.49 (China). These estimates suggest that each unit increase in PNS is associated with a 21% reduction in the odds of poor overall sleep quality in the past 30 days in India and a 51% reduction in China. PNS is unrelated to the odds of poor overall sleep quality in the past 30 days in Ghana.

3.3. Multivariate overview

We formally tested 39 associations of PNS with seven sleep outcomes. In total, 12 odds ratios failed to reach statistical significance ($p < 0.05$). This means that PNS was unrelated to the sleep quality and sleep duration measures 31% of the time across countries. It should be noted, however, that nine of the 12 (75%) odds ratios that failed to reach statistical significance were limited to only three countries (Ghana, South Africa, and India).

In total, 26 odds ratios were determined to be statistically significant. Twenty-five of these odds ratios (64%) suggested that higher levels of PNS were associated with more favorable sleep outcomes. This general pattern was most consistent in China and Russia. In fact, PNS was protective for five of seven (71%) outcomes in Russia and six of seven (86%) outcomes in China. PNS was moderately effective in Ghana and South Africa. In these countries, PNS was protective for four of seven (57%) outcomes. PNS was apparently least effective in India. In this country, PNS was only protective for three of seven (43%) outcomes. Given that we did not have data for three sleep outcomes, our overall assessment of Mexico should be interpreted with caution. However, we did find that PNS was protective for three of four outcomes for which we had data.

Our analyses suggest that certain sleep outcomes were more sensitive to PNS than others. PNS was most consistently related to sleep outcomes with longer reference periods (30 days and 12 months). We observed that PNS was protective against insomnia over the past 12 months and poor sleep quality in the past 30 days in five of six (83%) countries. PNS was moderately protective against sleepiness, lethargy, and poor sleep quality in the past two days in four of six (67%) countries. PNS was protective against long sleep in one of six (17%) countries and short sleep in two of six (33%) countries.

4. Discussion

Building on previous North American and European studies of neighborhood context and sleep quality, we tested whether several self-reported sleep outcomes (sleep duration, insomnia symptoms, sleepiness, lethargy, and overall sleep quality) vary according to the level of perceived neighborhood safety (PNS) in six countries: Mexico, Ghana, South Africa, India, China, and Russia.

Taken together, the results of our multivariate regression analyses show that respondents who feel safe from crime and violence in their neighborhoods tend to exhibit more favorable sleep outcomes than respondents who feel less safe in their neighborhoods. This general pattern, observed across several sleep outcomes and across several countries, is largely consistent with previous studies conducted in the USA, Canada, England, and Germany [1–13]. Our findings are especially close to the work of Steptoe and colleagues [13]. In their study of middle-aged and older adults in England, they found that fear of crime in the neighborhood was positively associated with sleep problems (eg, trouble falling asleep and difficulty staying asleep). To the best of our knowledge, we are the first to formally assess the association between neighborhood context and sleep quality in Mexico, Ghana, South Africa, India, China, and Russia.

It is unclear why PNS is more consistently related to sleep outcomes in certain countries (eg, China and Russia). On the one hand, there may be significant structural differences in residential segregation and neighborhood socioeconomic disadvantage across countries. Structural differences such as these could condition the production of problems in the neighborhood (eg, rates of crime in the neighborhood) and the subjective experiences of residents (eg, the perception that crime in the neighborhood is problematic). On the other hand, there are likely to be notable cultural differences in sleep customs and the social construction or meaning of neighborhood life. While some countries have, for example, established napping cultures, others do not. Countries characterized by safe neighborhoods are likely to develop cultural preferences for peaceful environments; however, countries defined by unsafe

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neighborhoods may never develop such expectations. Do violations of cultural preferences translate into sleep disturbance? How do concerns with neighborhood safety undermine sleep quality in the absence of cultural expectations? We can begin to answer these questions through preliminary qualitative studies.

The current study has two notable strengths. The first is rich and comparable sleep data across several understudied countries. The second is high external validity. Lucas [21] defines external validity as (1) generalizing to populations (through probability sampling) and as (2) generalizing across populations and settings (through replication). Unlike most previous studies of neighborhood context and sleep, our data allow us to achieve both forms of external validity by generalizing to *and* across six countries.

The current study is also limited in several respects. Because our data are cross-sectional, we cannot establish (empirically) any causal relationships among our focal variables. Although we suggest that feeling insecure and vulnerable in one's neighborhood environment could disturb healthy sleep patterns, it is also plausible that sleep problems could enhance feelings of fear (in the first place) by disrupting the natural circadian rhythm [6,22,23]. When established sleep–wake schedules are compromised (eg, under the conditions of sleep deprivation), the brain restricts the release of neurotransmitters (serotonin and norepinephrine) that help to regulate mood. We began the paper by speculating that chronic perceptions of danger in one's living environment could undermine sleep by contributing to chronic or generalized states of emotional or physiological distress. However, we must acknowledge the possibility that preexisting emotional or physiological issues could lead residents to feel less safe in their neighborhoods and to exhibit poorer sleep outcomes. Given the cross-sectional nature of the data, we cannot exclude these alternative models.

Because our perceived neighborhood safety index is based on only two items, reliability estimates are rather low across countries. This suggests that any associations with this index are likely to be conservative. Our sleep measures are also restricted to self-reports that are likely to reflect cultural differences in responses to questions about sleep quality. We address this issue by analyzing each country individually. Self-reported data on usual sleep duration are imperfect, but fairly reliable [24]. One study of adults in the USA showed that self-reported sleep duration can be approximately 48 minutes longer than objectively measured sleep duration [25]; however, to our knowledge, such discrepancies have not been established in the six countries included in this study.

Given these limitations, additional research is needed to replicate our analyses using longitudinal data, more reliable measures of neighborhood context, and more direct measures of sleep duration and quality with longer reference periods. We also recommend that future studies investigate the associations between neighborhood context and sleep patterns in other understudied regions of the world. While previous studies have emphasized the United States and, to a lesser extent, Canada, England, and Germany, we have stretched the North American context to Mexico and have contributed data from Africa (Ghana and South Africa), south-central Asia (India), eastern Asia (China), and northern Asia (Russian Federation). Do the patterns observed in this study and previous work extend to Central America, the Caribbean, South America, Europe, West Asia/the Middle East, and Southeast Asia? Subsequent studies should also consider whether the effects of neighborhood context vary according to theoretically relevant subgroups (eg, age, gender, and socioeconomic status). For example, are women or men especially vulnerable to lower levels of neighborhood safety? Research along these lines would provide a more global and nuanced understanding of the extent to which sleep outcomes vary according to neighborhood context.

5. Conclusions

In this paper, we tested whether several self-reported sleep outcomes vary according to the level of perceived neighborhood safety in six countries. Our key finding is that respondents who feel safe from crime and violence in their neighborhoods tend to exhibit more favorable sleep outcomes than respondents who feel less safe in their neighborhoods.

Conflict of interest

The ICMJE Uniform Disclosure Form for Potential Conflicts of Interest associated with this article can be viewed by clicking on the following link: http://dx.doi.org/10.1016/j.sleep.2014.12.003.

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